

Fig.1

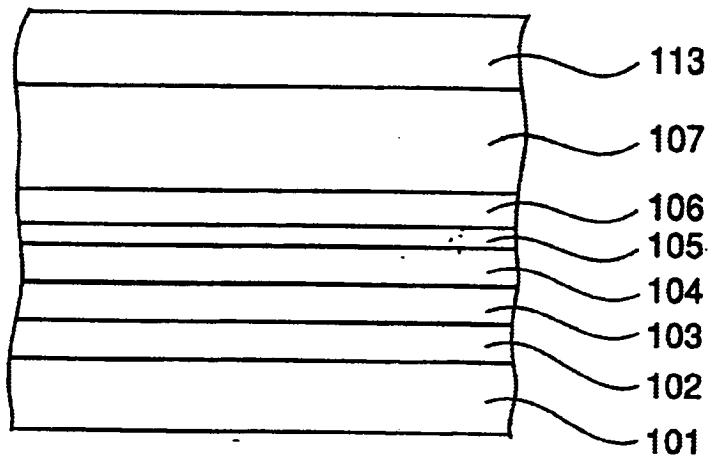


Fig.2

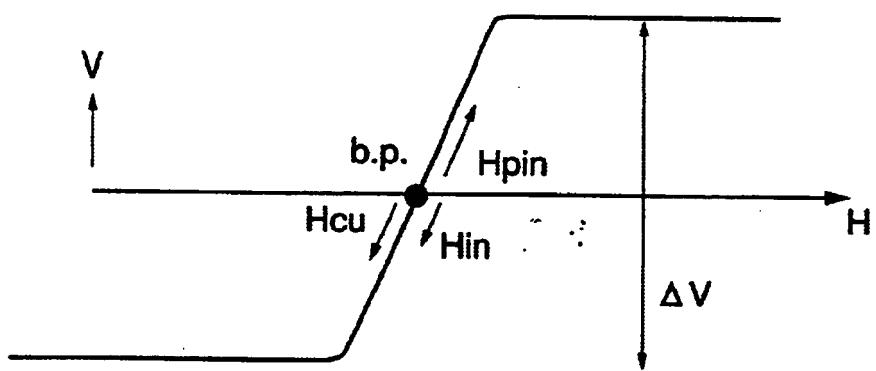


Fig.3

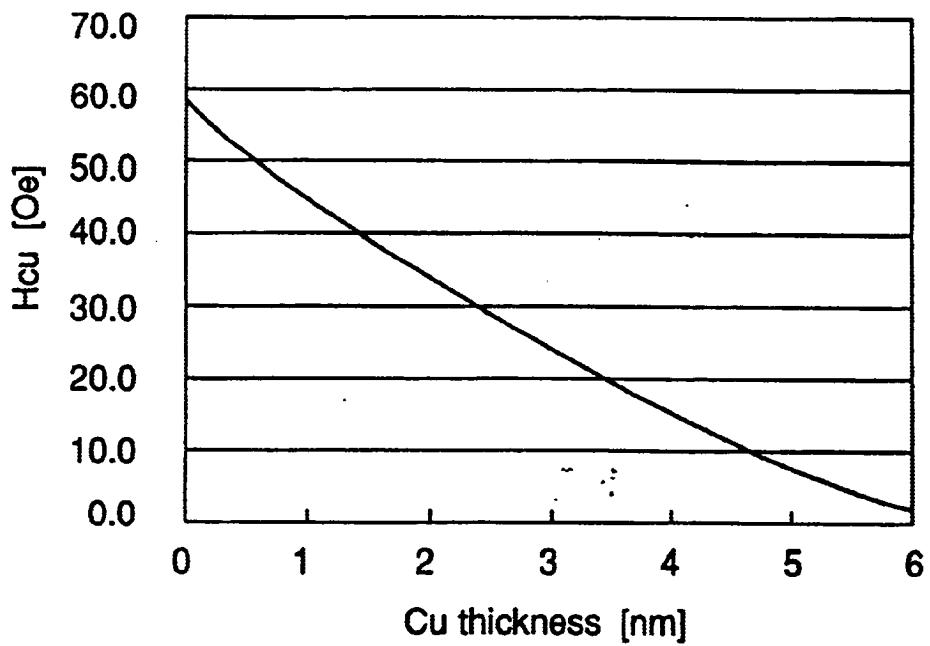


Fig.4

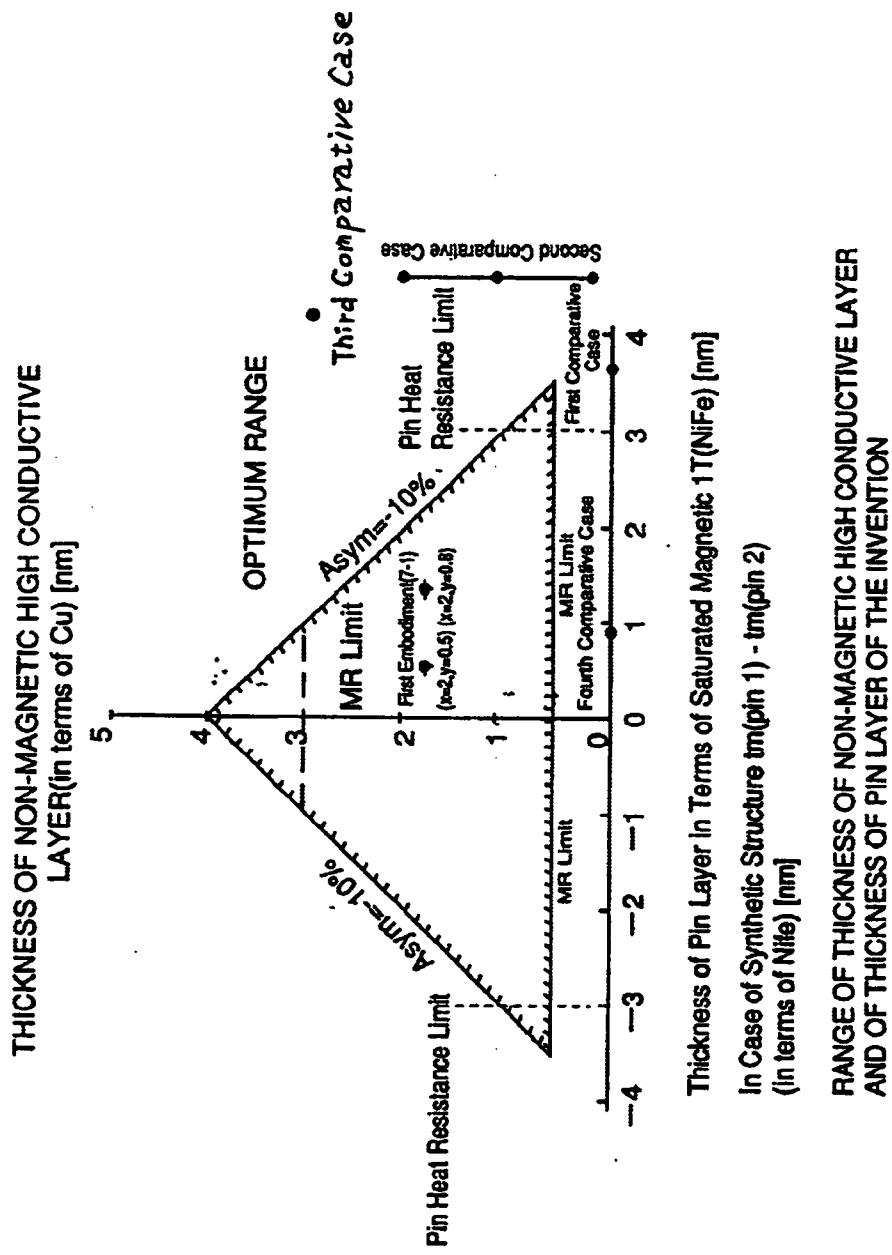
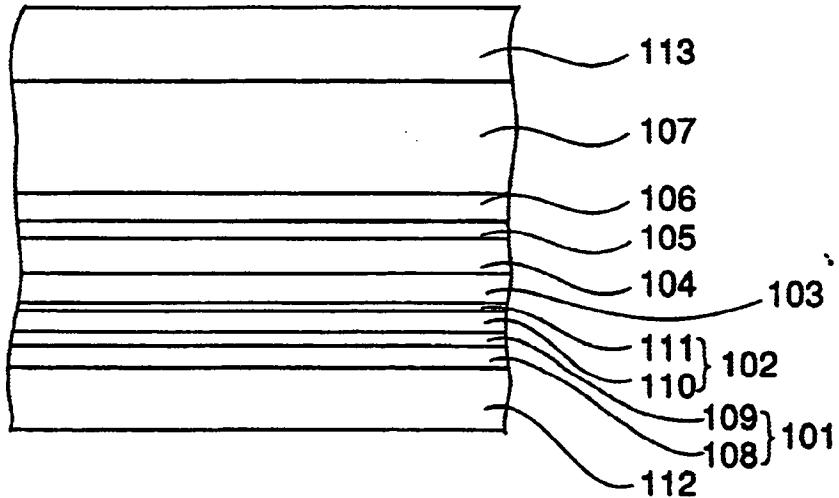
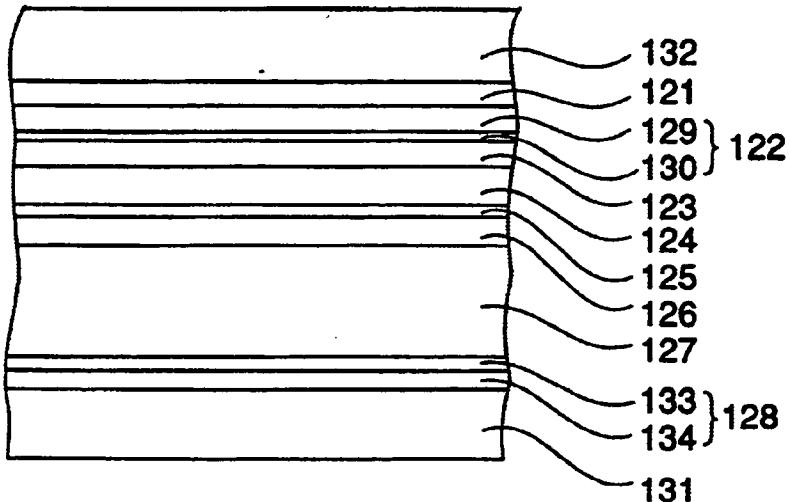


Fig.5

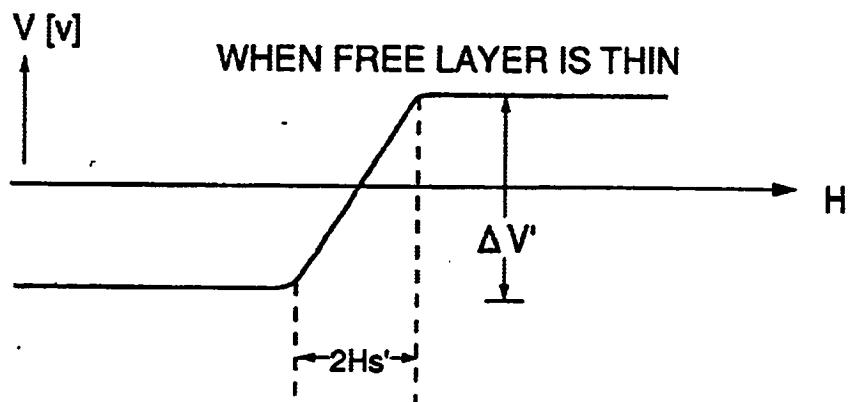
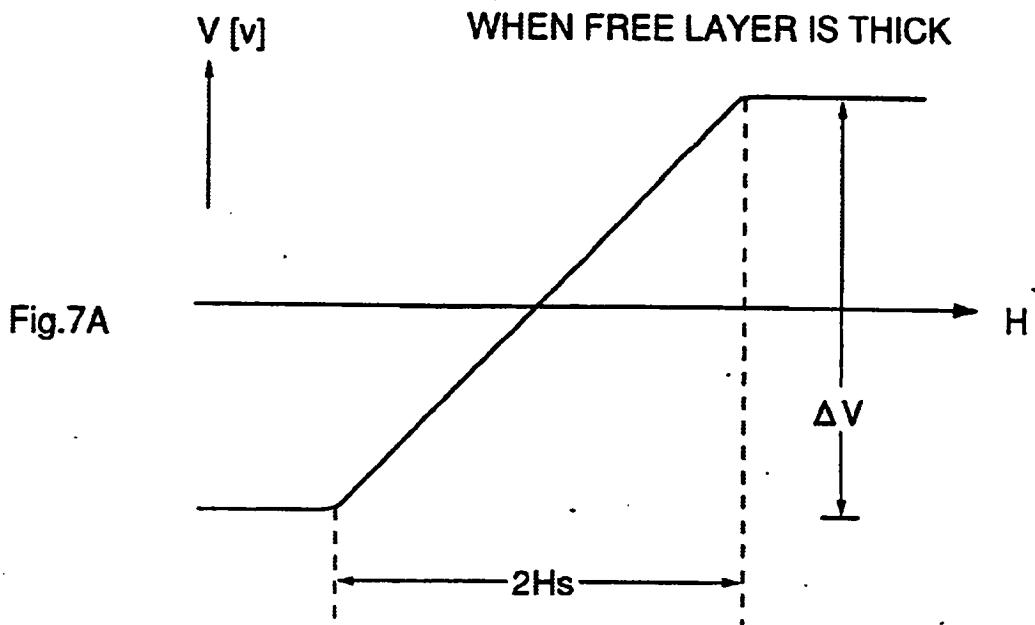


## EMBODIMENT IN TOP TYPE

Fig.6



## EMBODIMENT IN BOTTOM P TYPE



PROBLEMS WHEN FREE LAYER IS THIN:

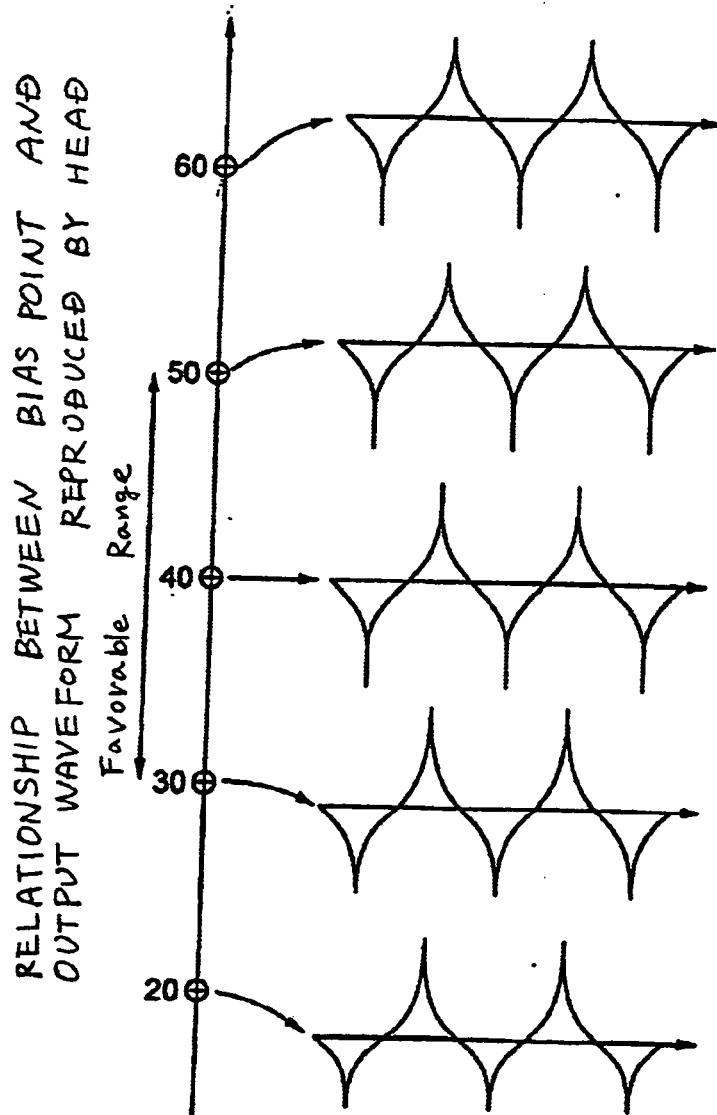
$H_s' < H_s$  (Inclination becomes sharp)

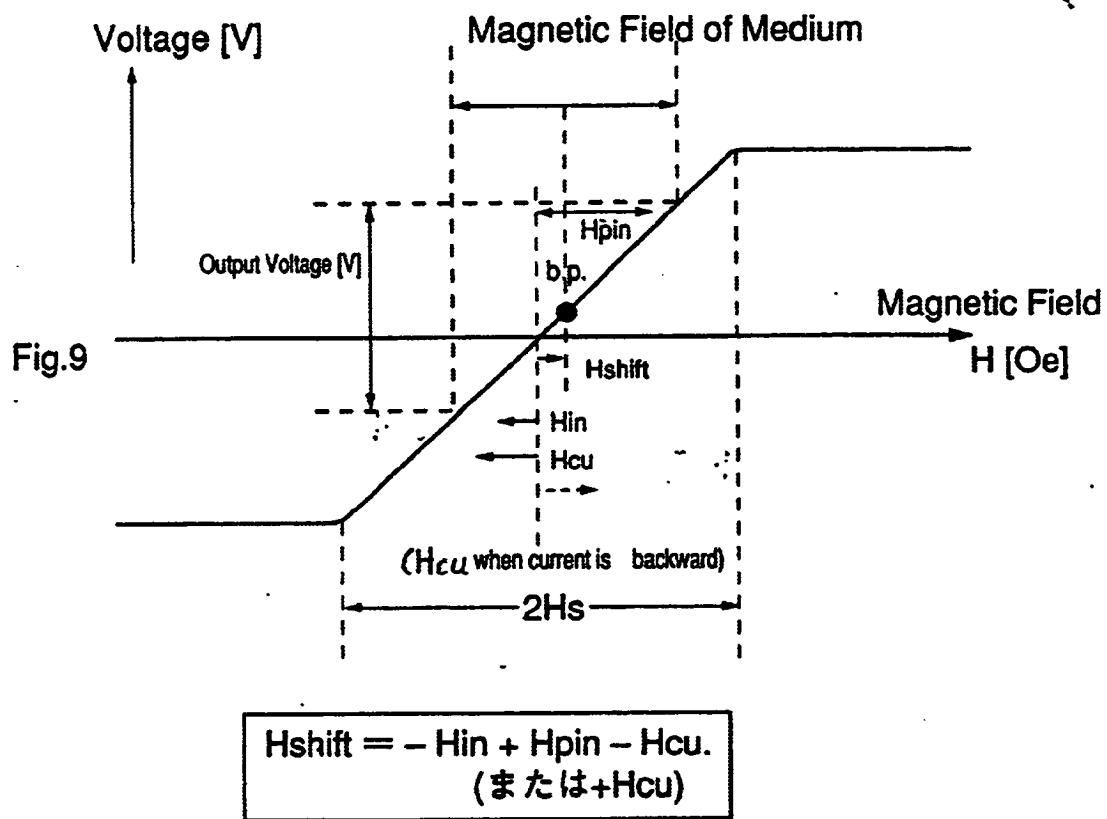
→ Hard to adjust bias point

-  $\Delta V' < \Delta V$  (HR ratio decreases)

→ Cannot produce output signal

BIAS POINT IN CALCULATION [%]

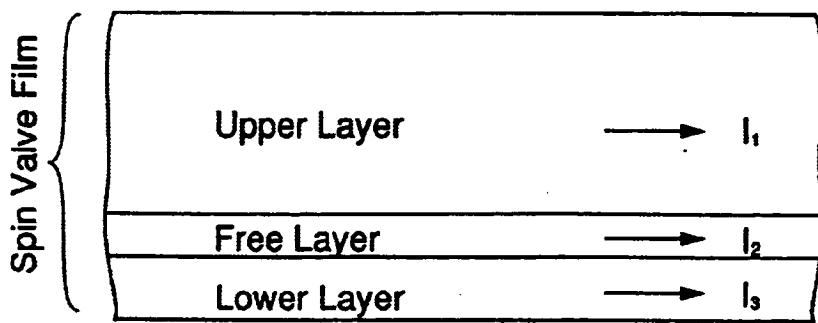




CONCEPTUAL GRAPH BIAS POINT (b.p.)  
INDICATED ON TRANSFER CURVE

PRINTED ON A SONY ZEUS 2000

Fig.10



Sense Current :  $I_s = I_1 + I_2 + I_3$  [mA]

DIAGRAMMATIC VIEW OF DIVIDED CURRENT FLOWS  
OF SPIN VALVE FILM

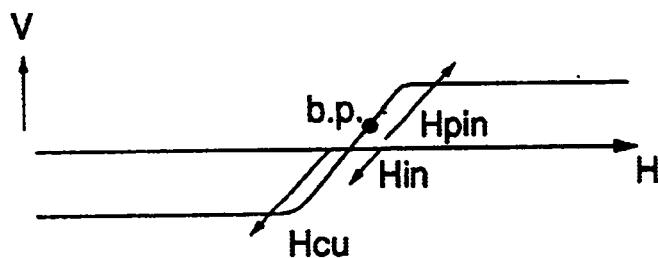
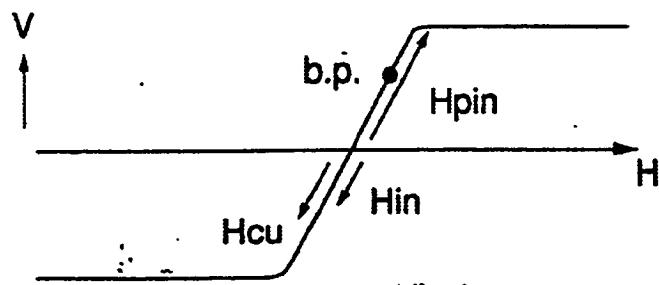


Fig.11

#### BIAS POINT OF FIRST COMPARATIVE CASE (No Spin Filter x Normal Pin)

- (- Controllability becomes bad to bring large  $H_{pin}$  to just bias by large  $H_{cu}$  (height dependency is large)
- Output drops because no Spin-Filter effect is utilized)

Fig.12



<sup>2<sup>nd</sup></sup>  
BIAS POINT OF COMPARATIVE CASE ( $S_{pin}$  Filter exists x Normal Pin)  
(b.p. increases considerably more than 50% because  $H_{pin}$  is large and  $H_{cu}$  is small)

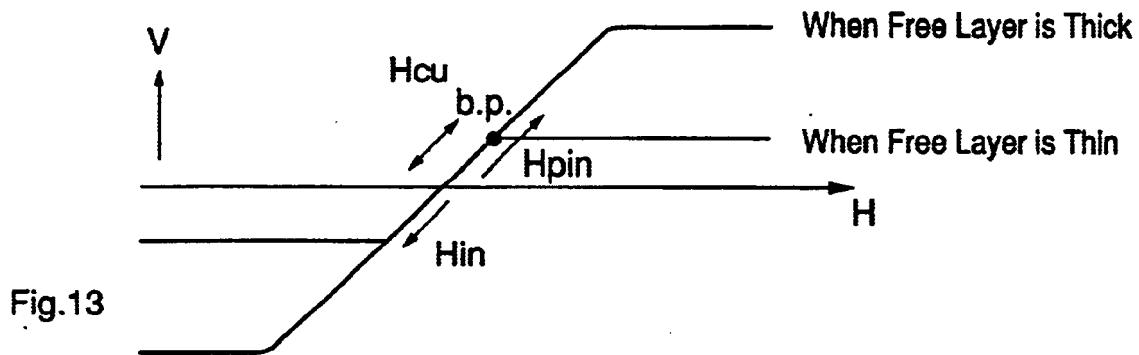


Fig.13

#### BIAS POINT OF THIRD COMPARATIVE CASE

(-Bias point is stabilized when free layer is thick just by decreasing Hcu.)

(-When free layer is thinned, influence of Hpin is large and b.p. deviates. MR also deteriorates)

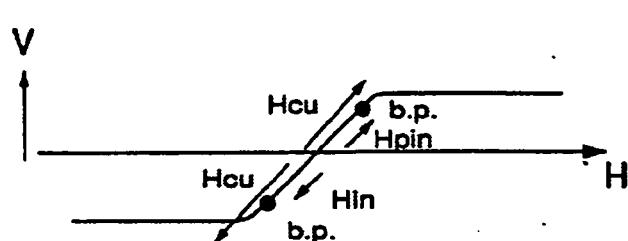


Fig.14

BIAS POINT OF FOURTH COMPARATIVE CASE (No Spin Filter x  
Synthetic AF)

(-Just bias cannot be obtained even when current is  
flown in either direction when  $H_{in}$  and  $H_{pin}$  are small and  
 $H_{cu}$  is large near the place where  $-H_{in}+H_{pin}$  is almost 50%)

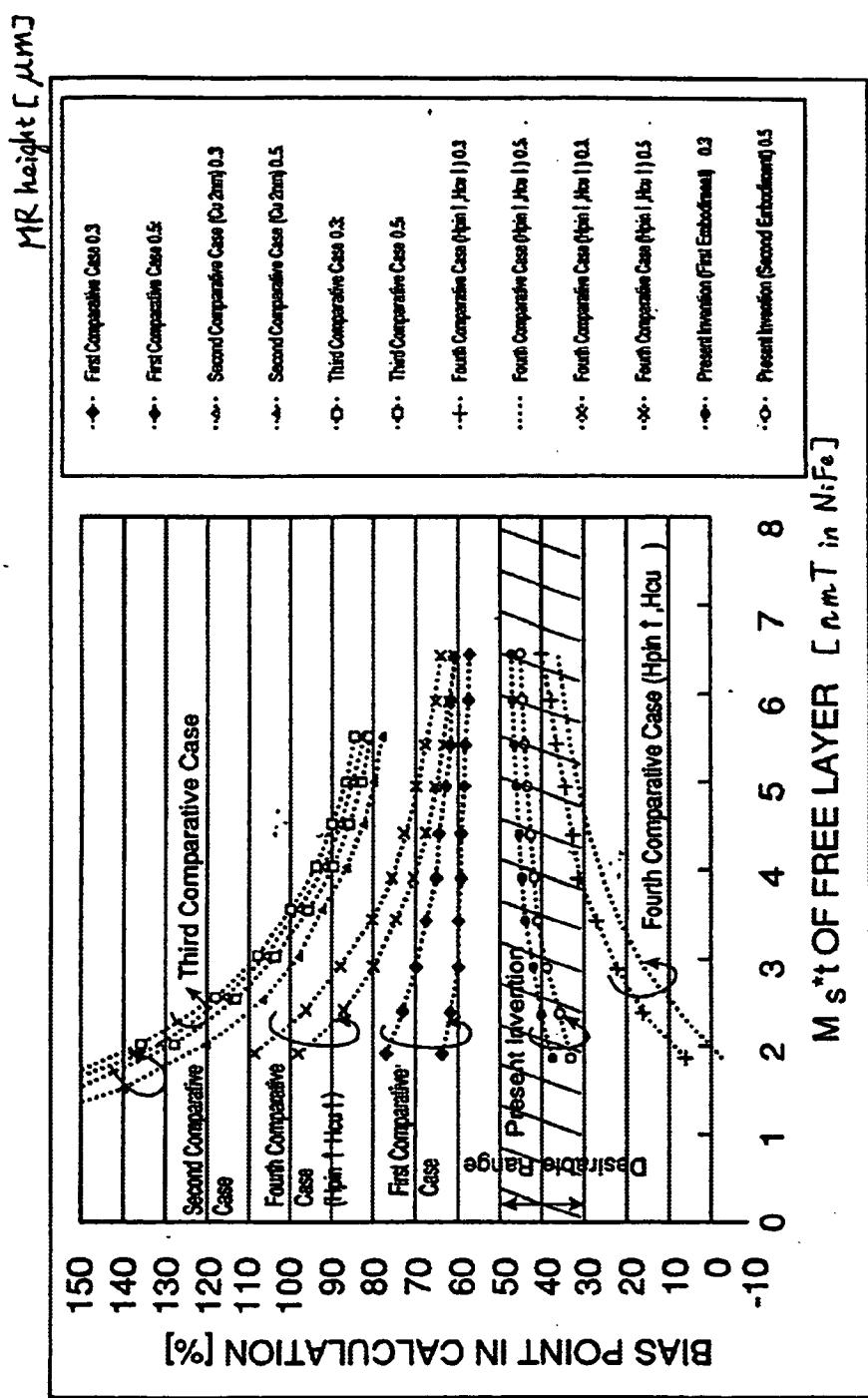
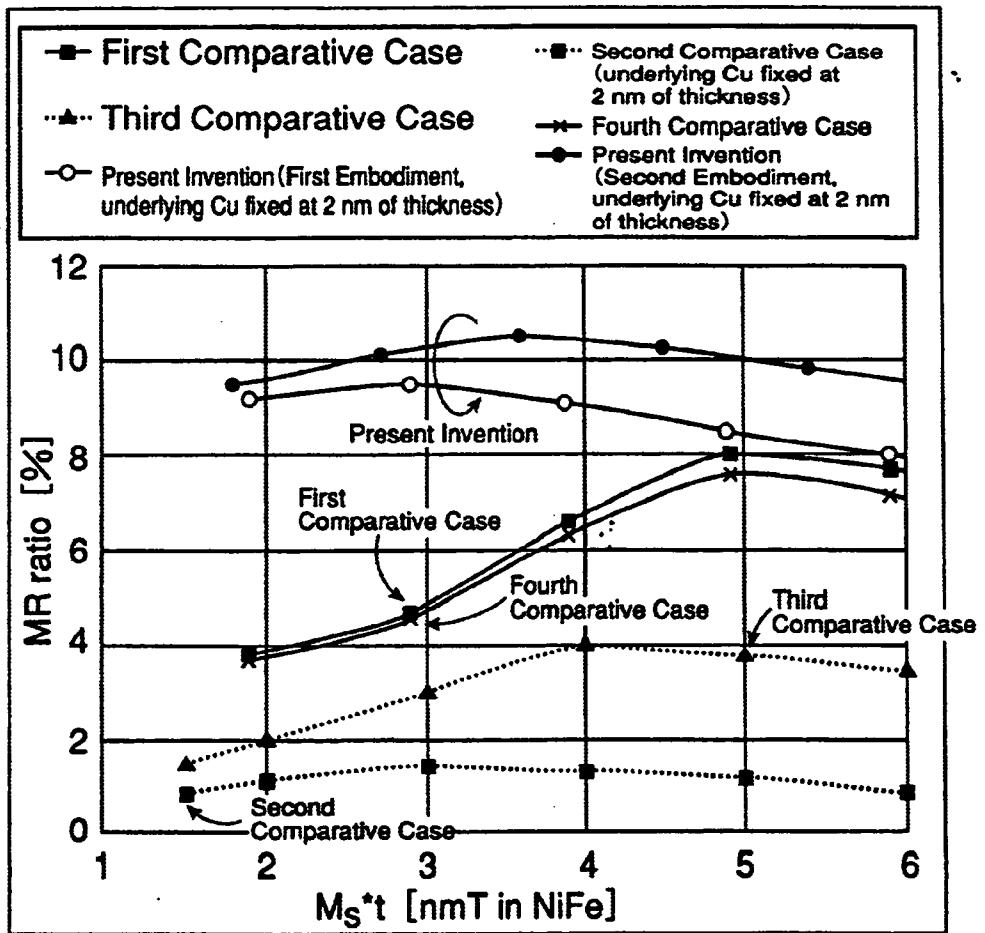


Fig.15

Fig.16



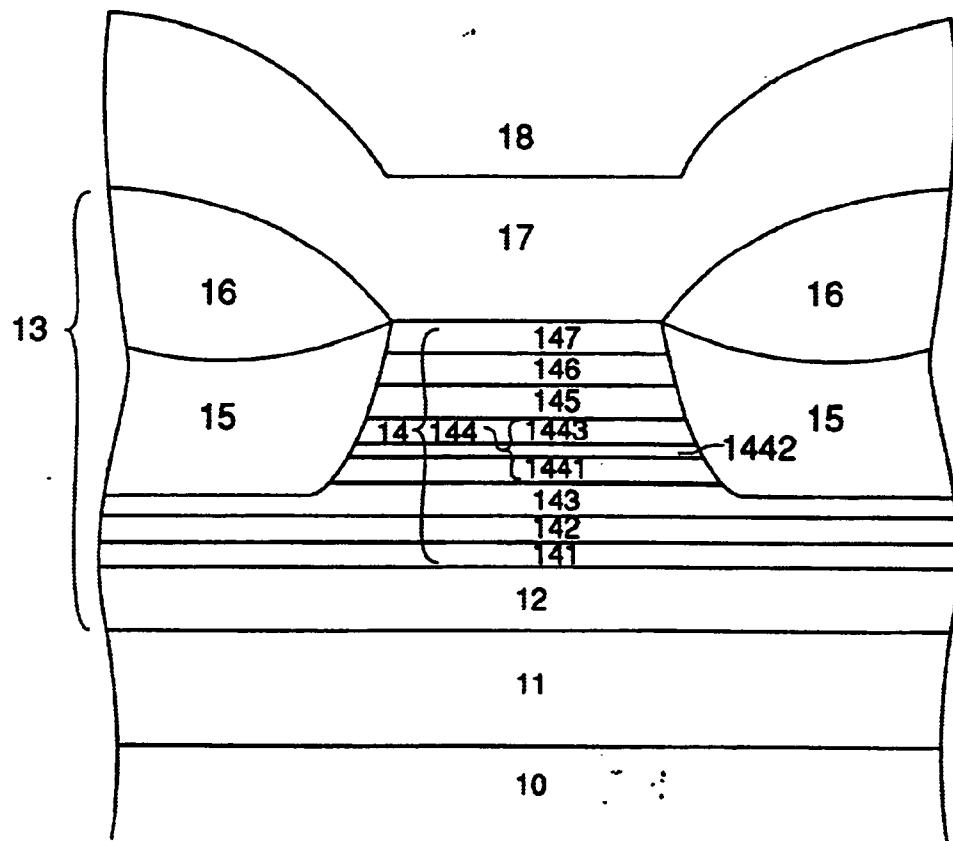


Fig.17

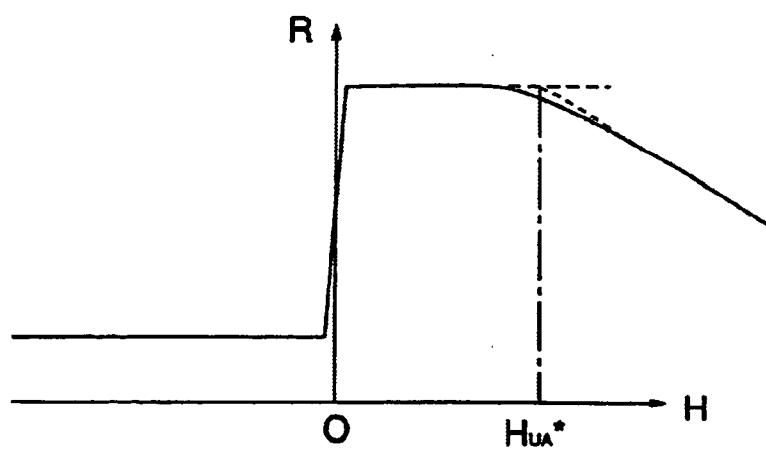


Fig.18

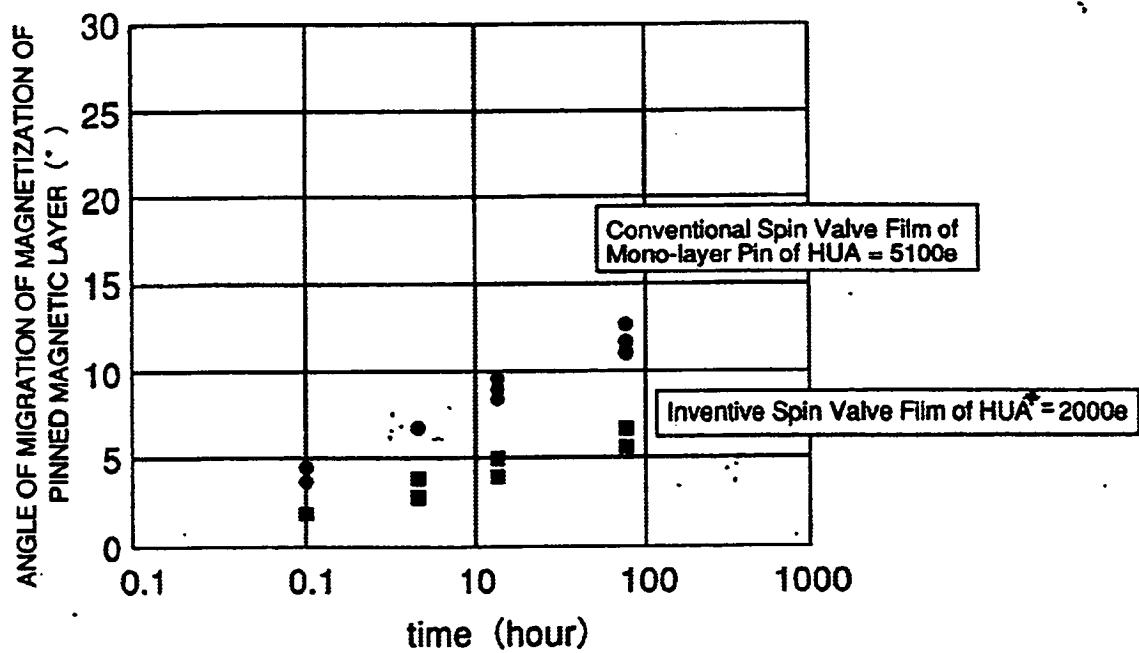
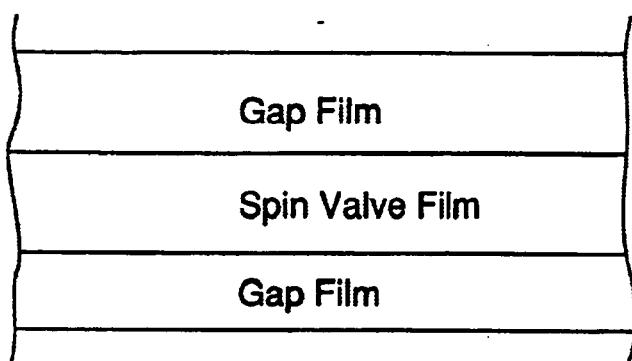
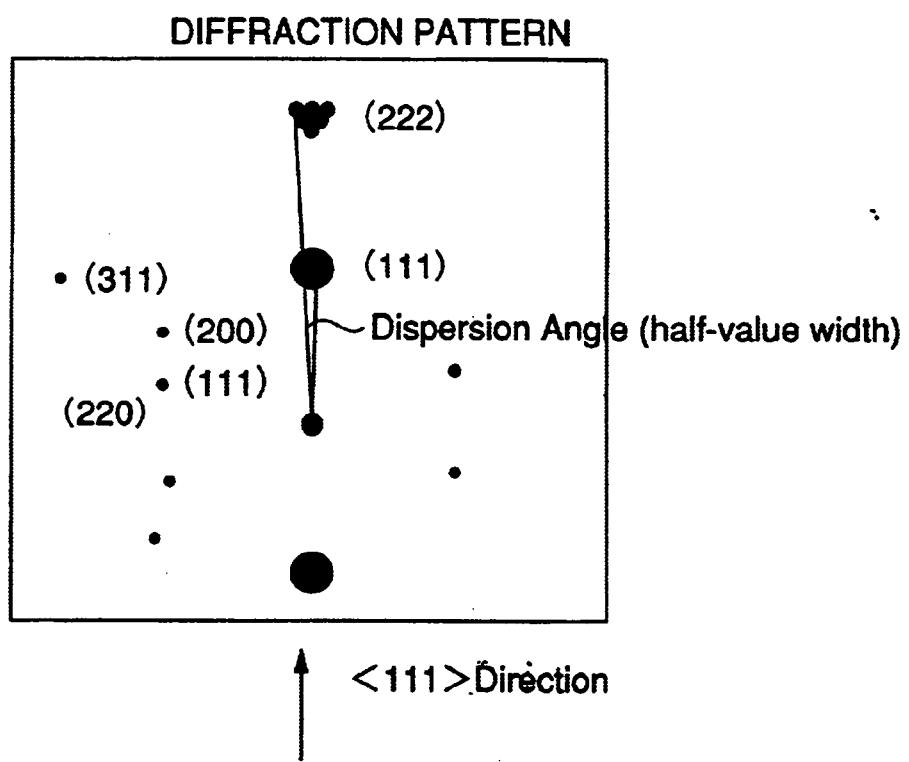


Fig.19

Fig.20



## SECTIONAL VIEW OF SPIN VALVE ELEMENT PART

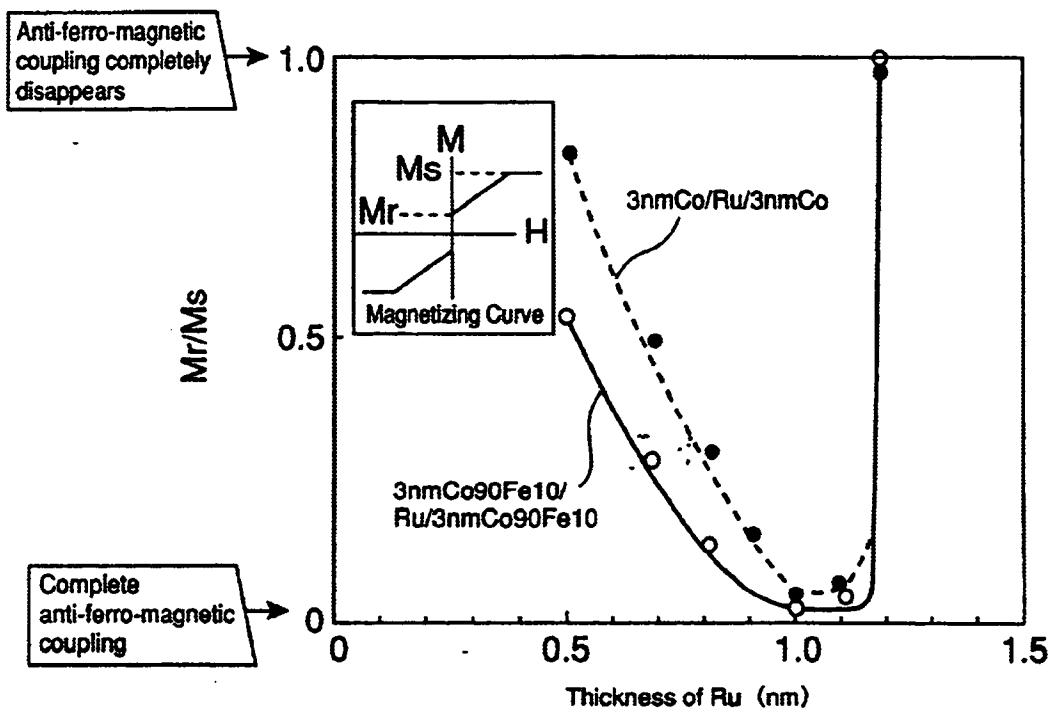


Fig.21

Fig.22A

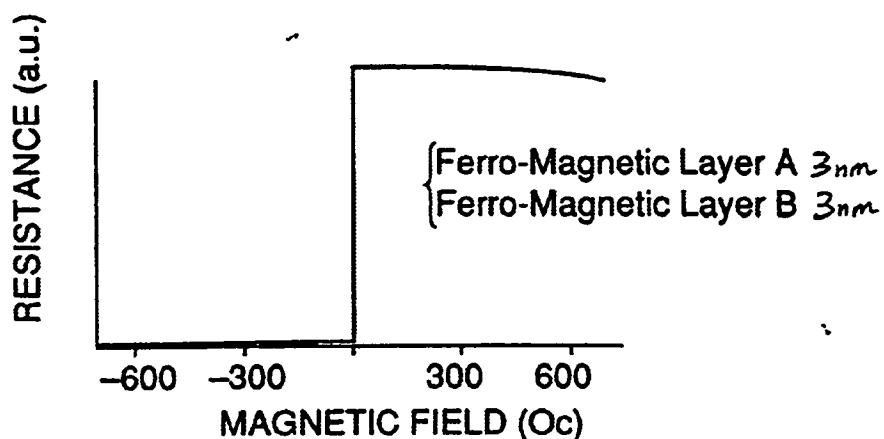


Fig.22B

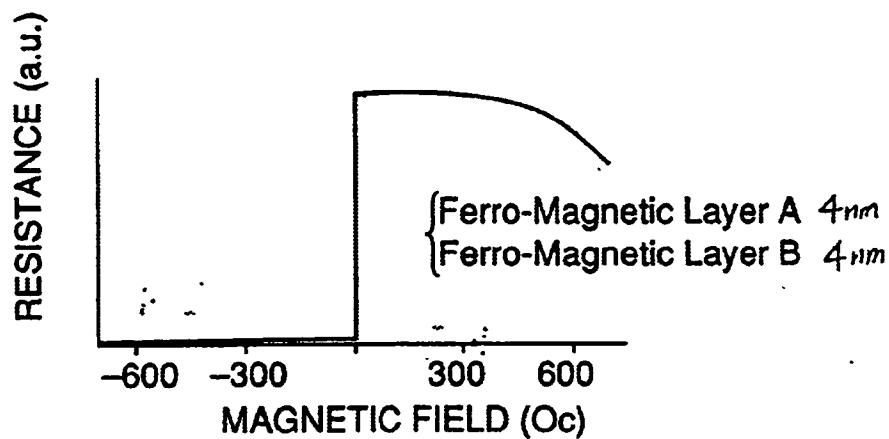


Fig.22C

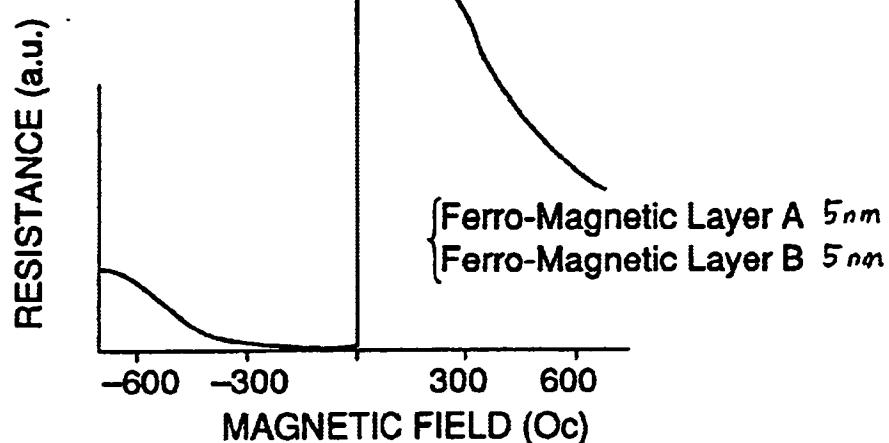


Fig.23A

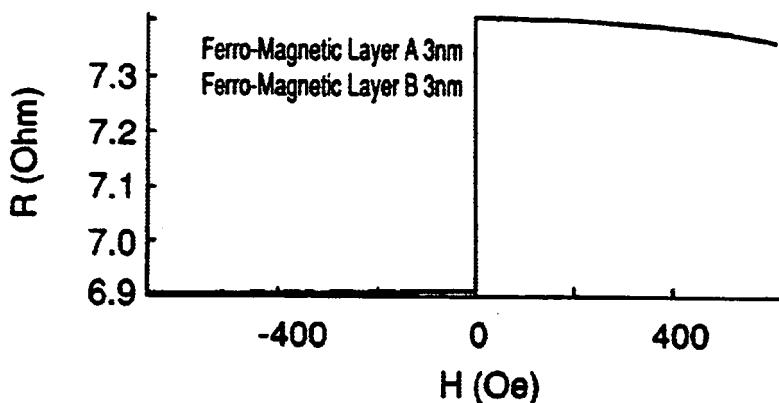


Fig.23B

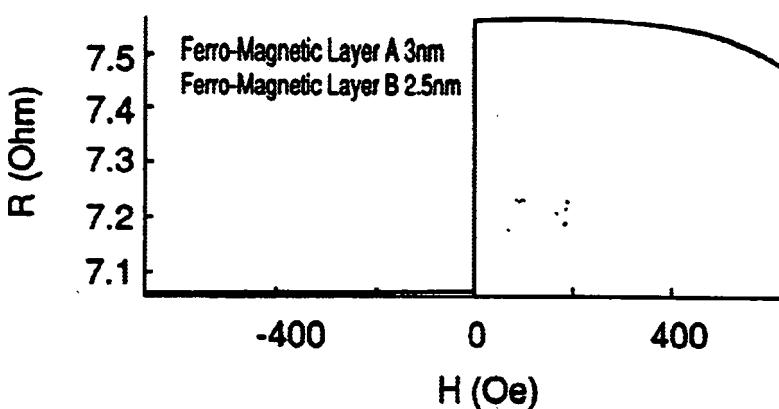


Fig.23C

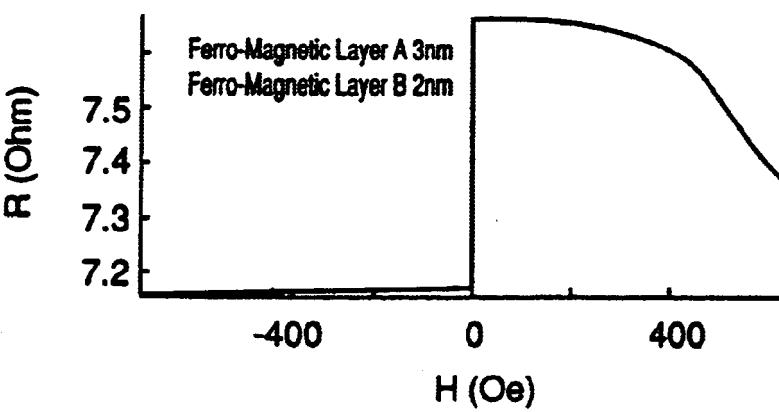


Fig.24A

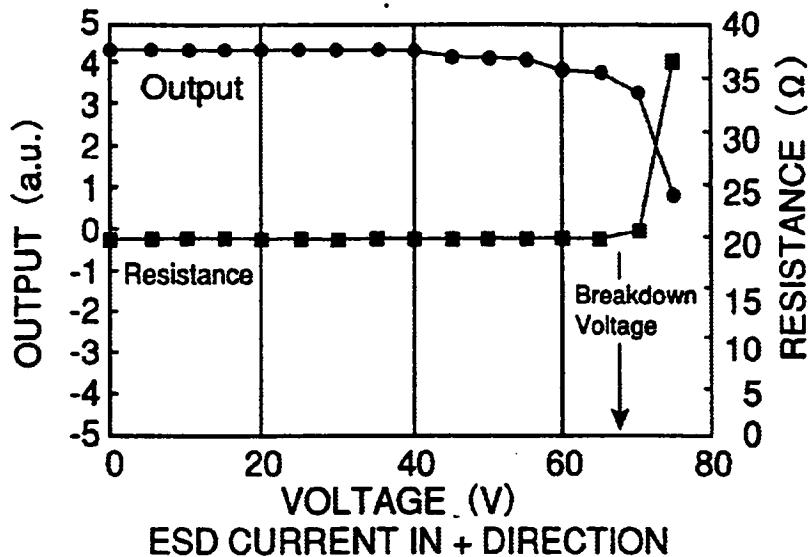
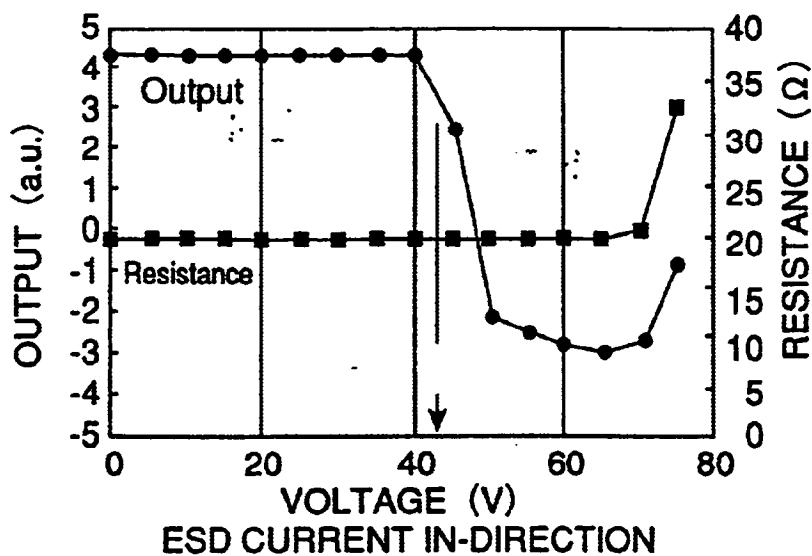


Fig.24B



### STRUCTURE OF SV FILM

{ VOLTAGE : ESD Voltage by Human Body Model.  
ESD CURRENT : + Direction is direction in which ESD Current  
Magnetic Field is applied in the Same Direction with Magnetization  
of Ferro-magnetic Layer B }

WHEN THICKNESS OF MAGNETIC LAYER OF  
FERRO-MAGNETIC LAYER A IS EQUAL WITH THAT OF  
FERRO-MAGNETIC LAYER B

Fig.25A

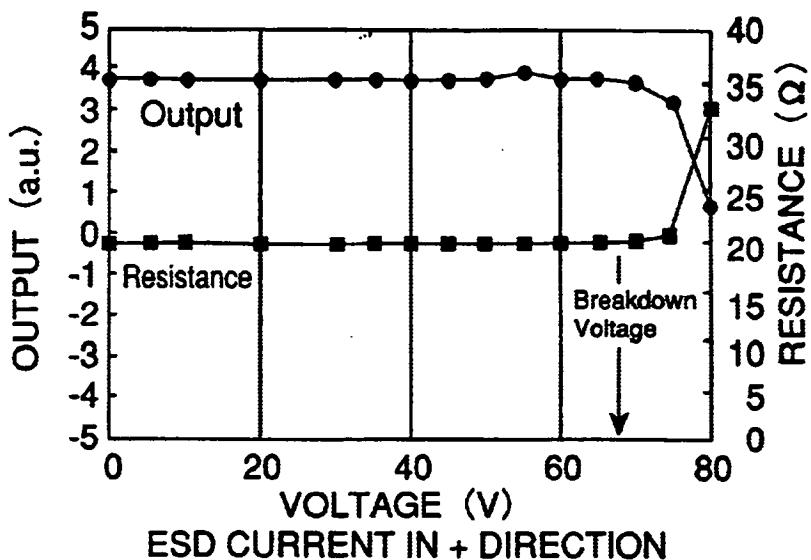
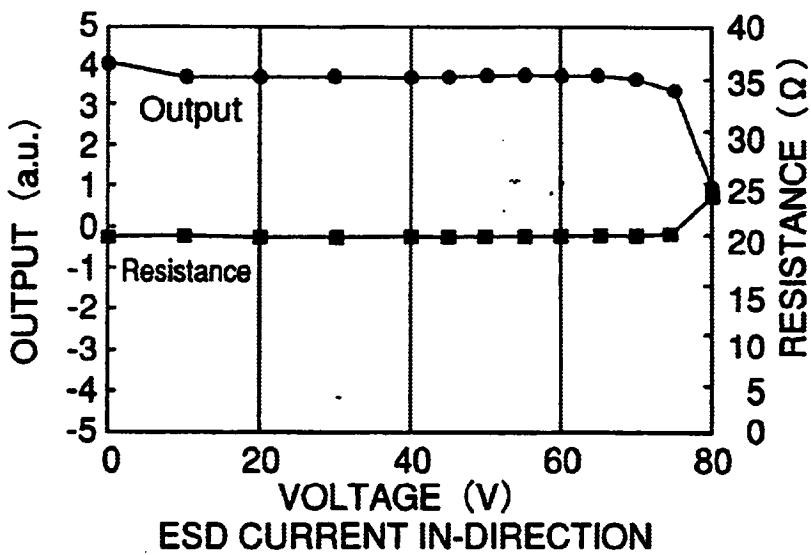


Fig.25B



#### STRUCTURE OF SV FILM

{ VOLTAGE : ESD Voltage by Human Body Model  
ESD CURRENT : + Direction is direction in which ESD Current  
Magnetic Field is applied in the Same Direction with Magnetization  
of Ferro - magnetic Layer B }

WHEN THICKNESS OF MAGNETIC LAYER OF  
FERRO-MAGNETIC LAYER A > THICKNESS OF MAGNETIC  
LAYER OF FERRO-MAGNETIC LAYER B

Fig.26

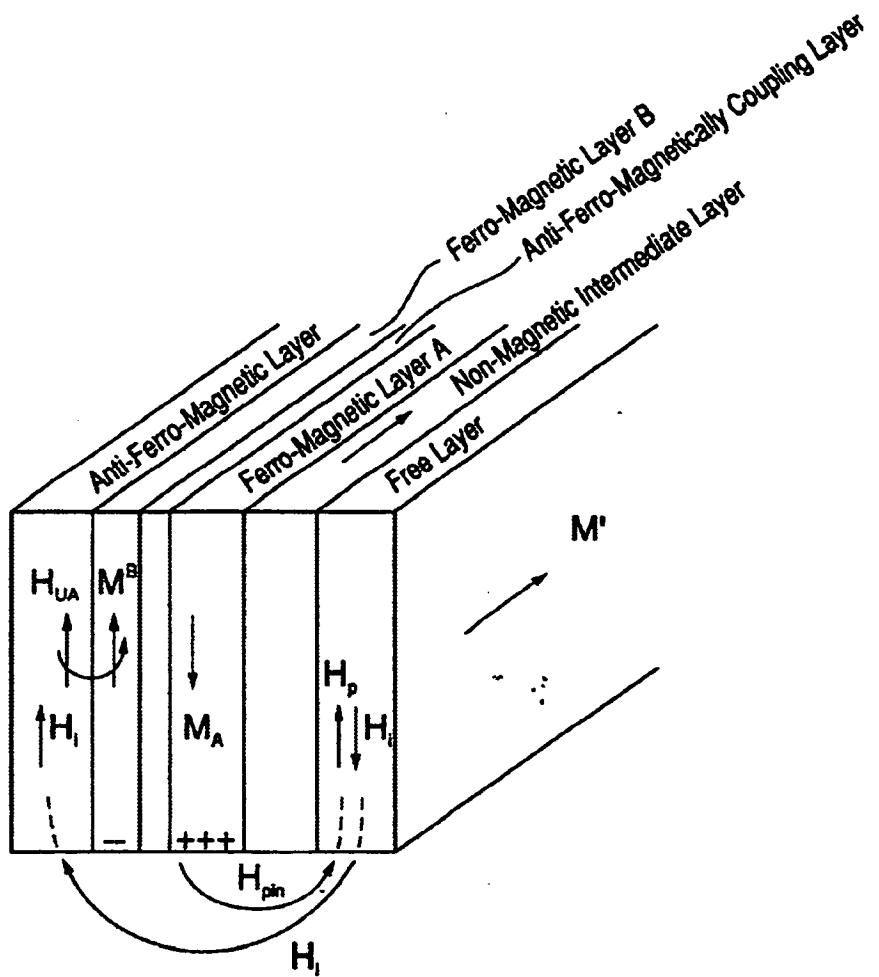


Fig.27

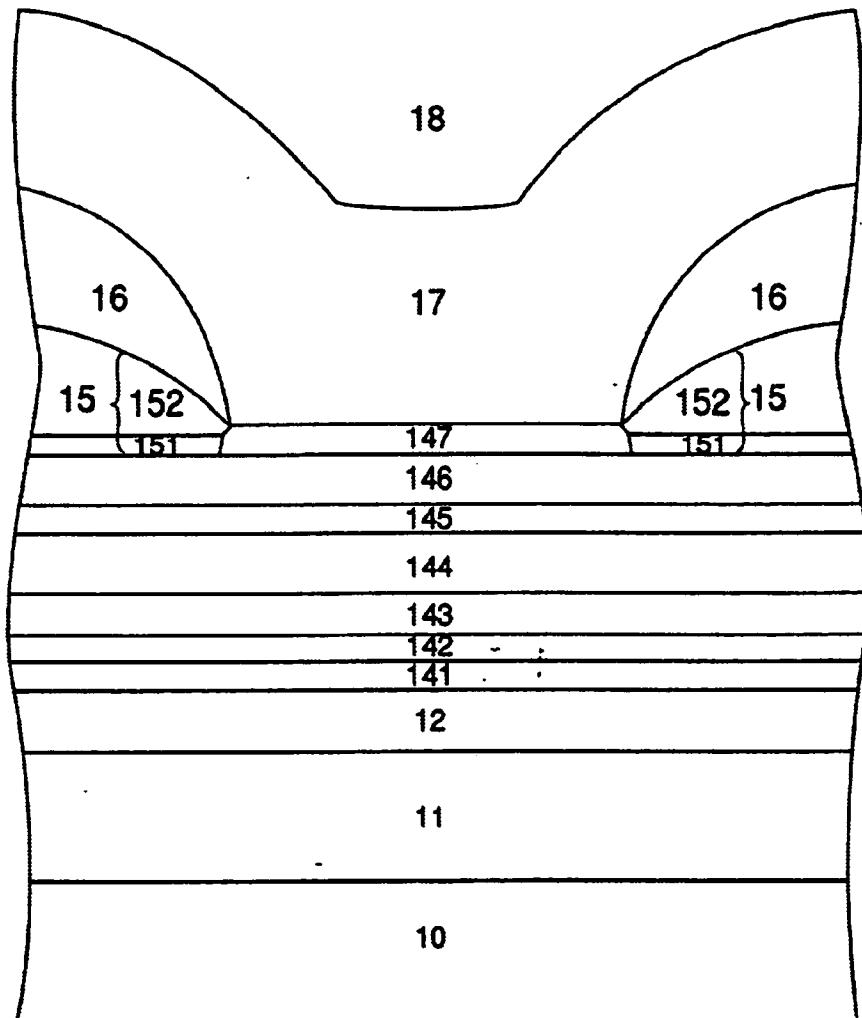


Fig.28

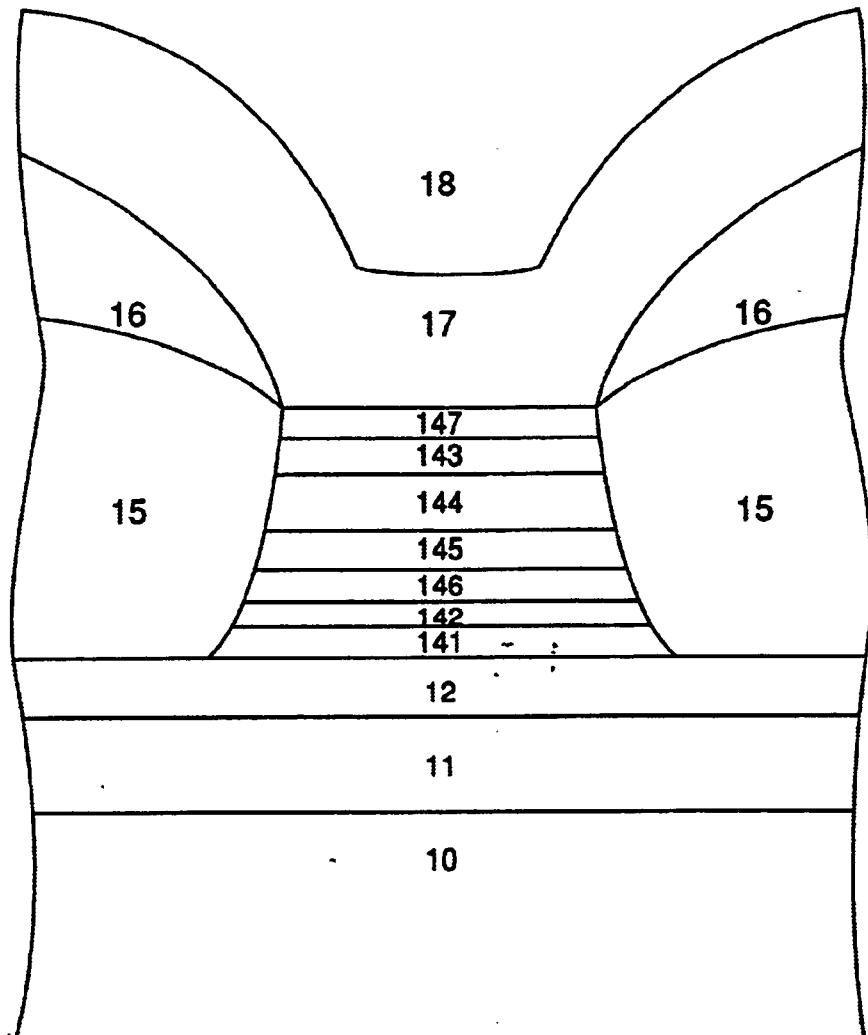


Fig.29

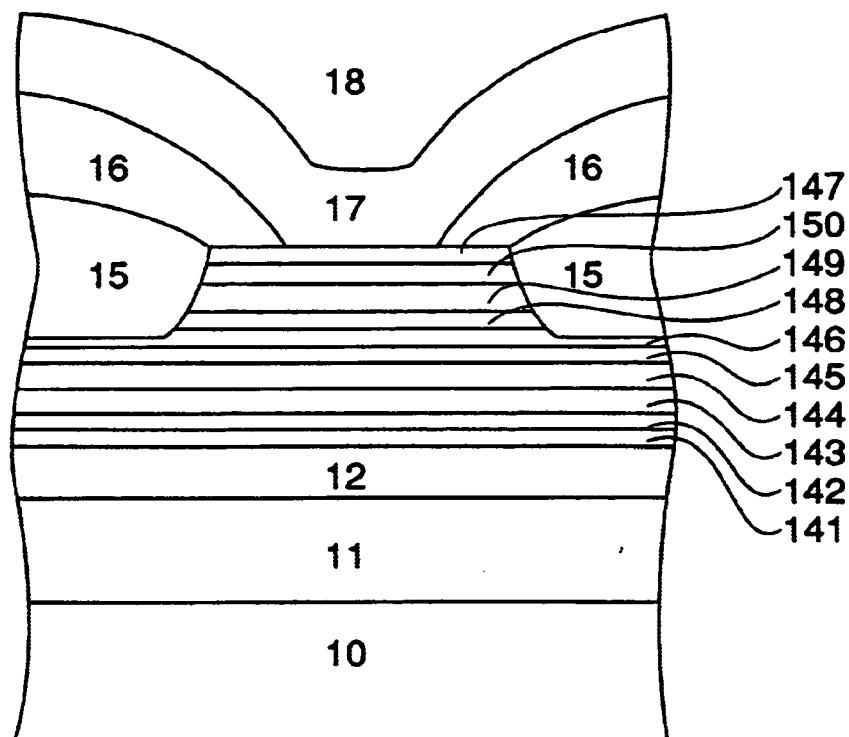


Fig.30

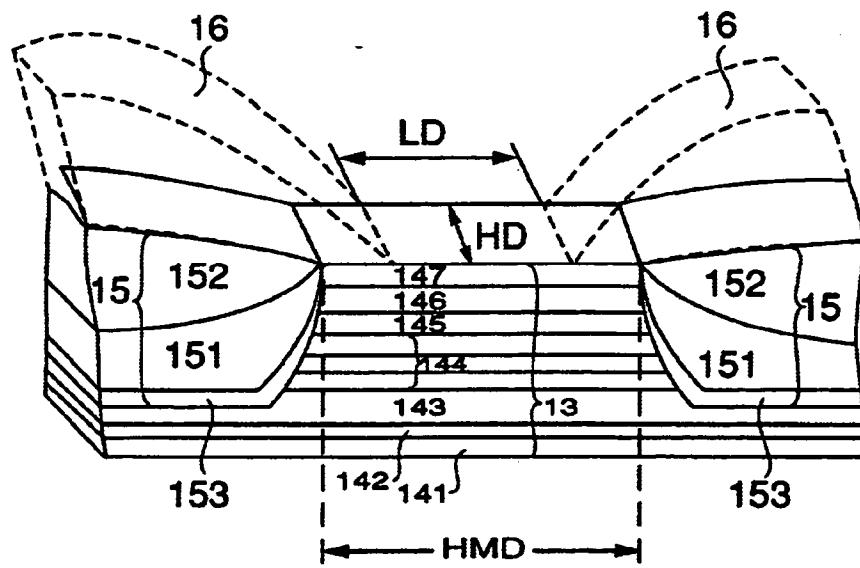


Fig.31

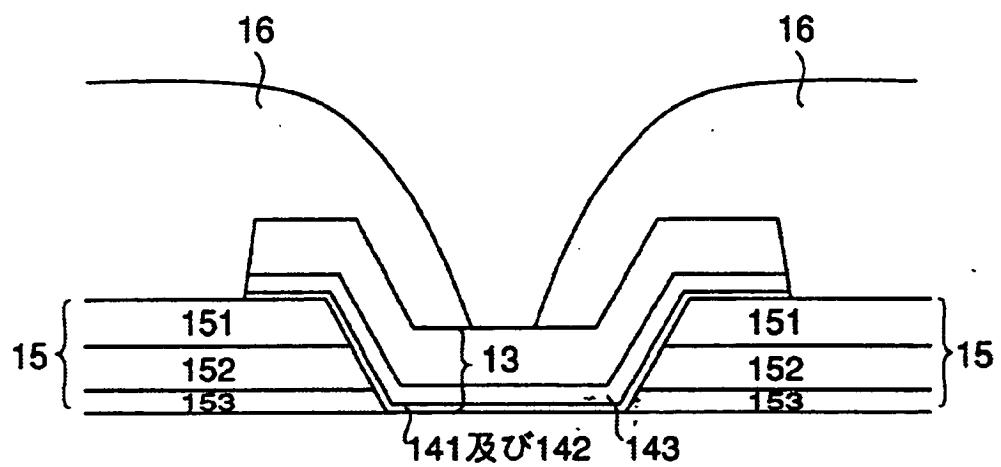


Fig.32

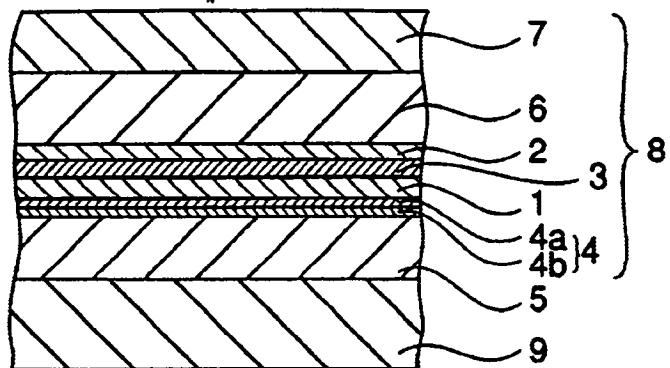


Fig.33

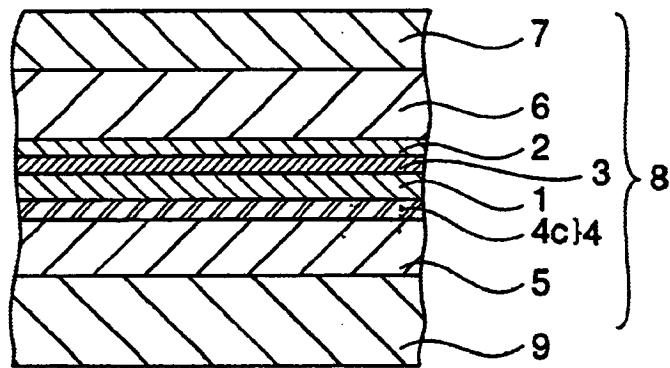


Fig.34

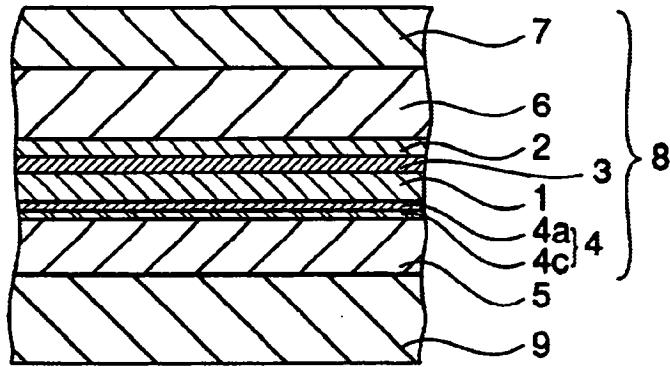


Fig.35A

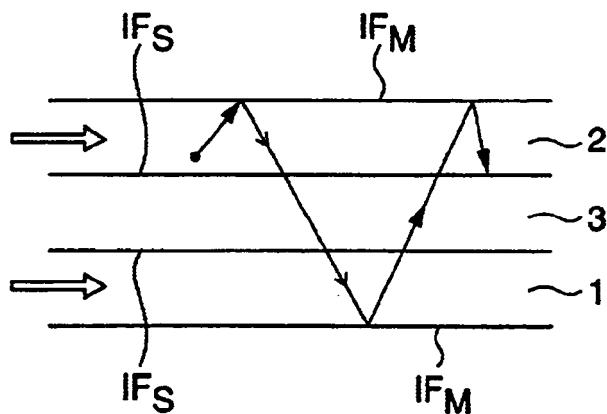


Fig.35B

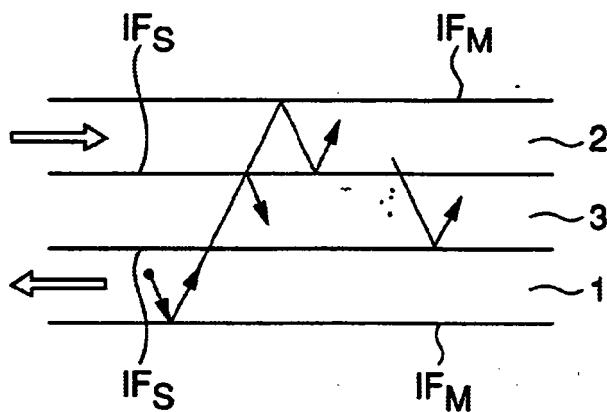
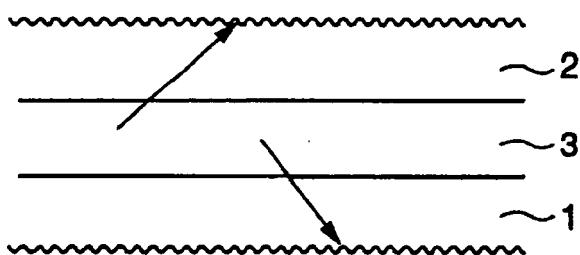


Fig.35C



31/  
43

Fig.36

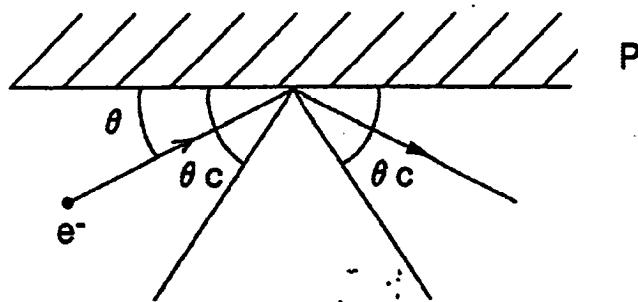


Fig.37A

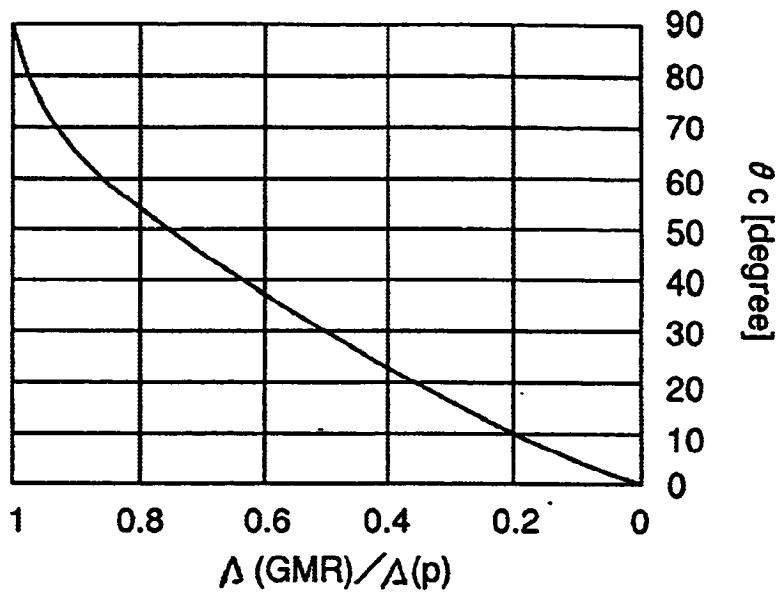


Fig.37B

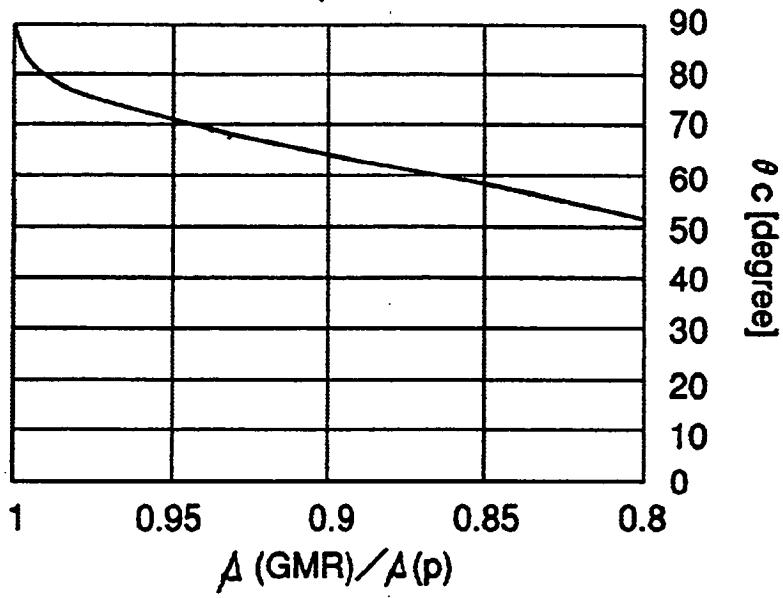


Fig.38

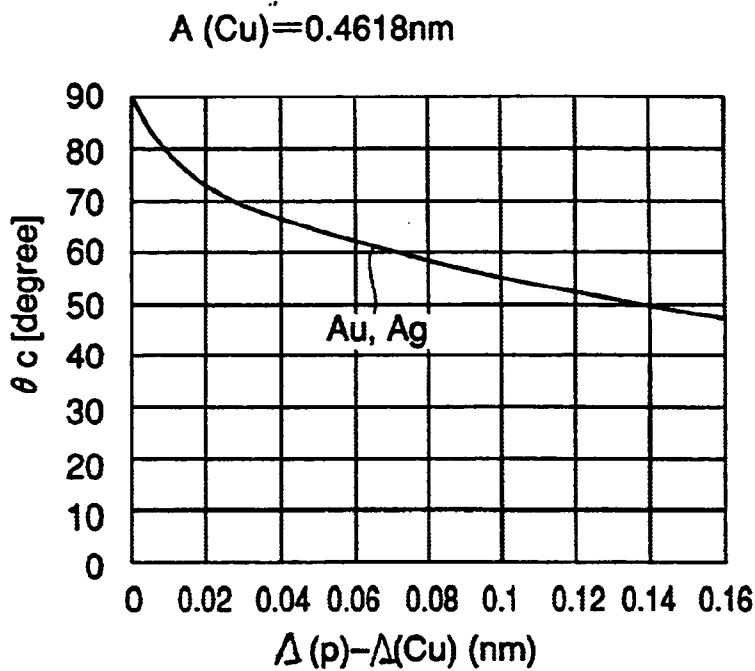


Fig.39

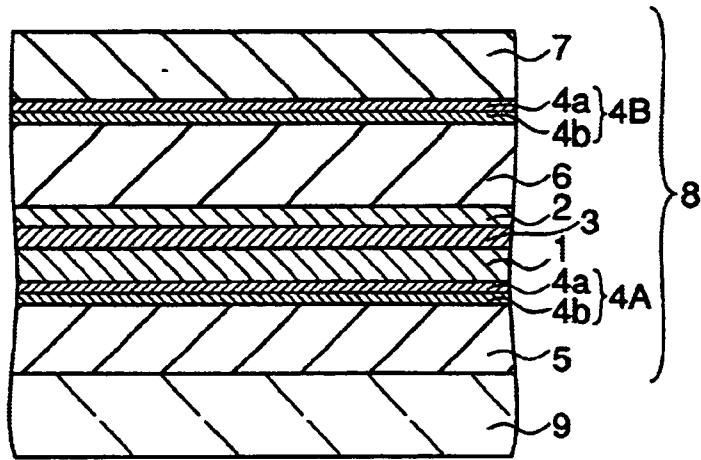


Fig.40

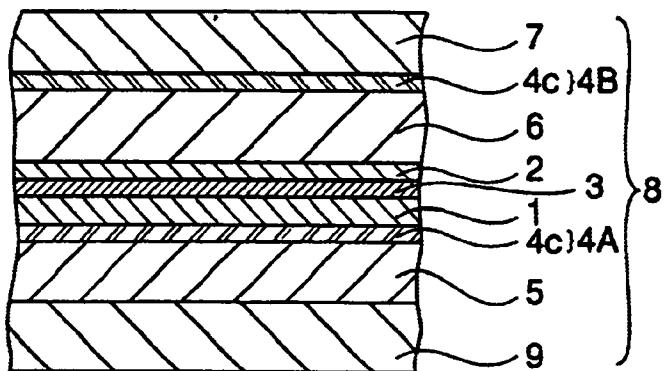


Fig.41

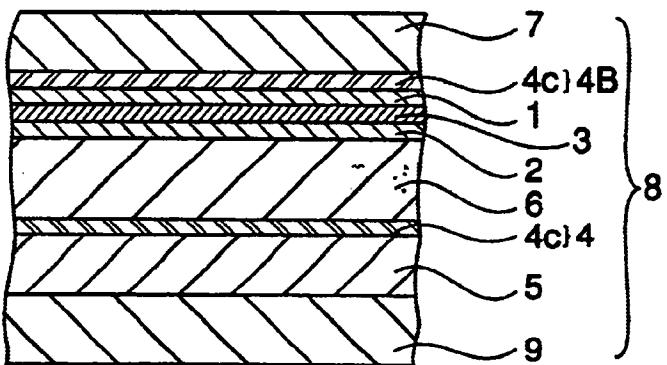
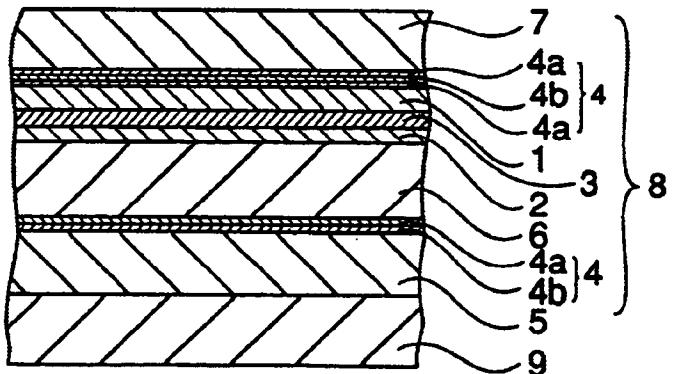


Fig.42



TOP TOE SEAMLESS

Fig.43

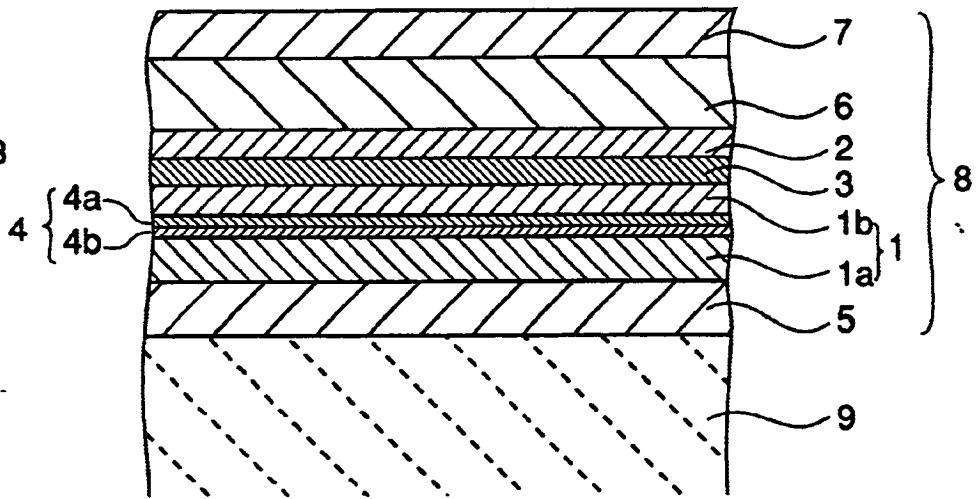


Fig.44

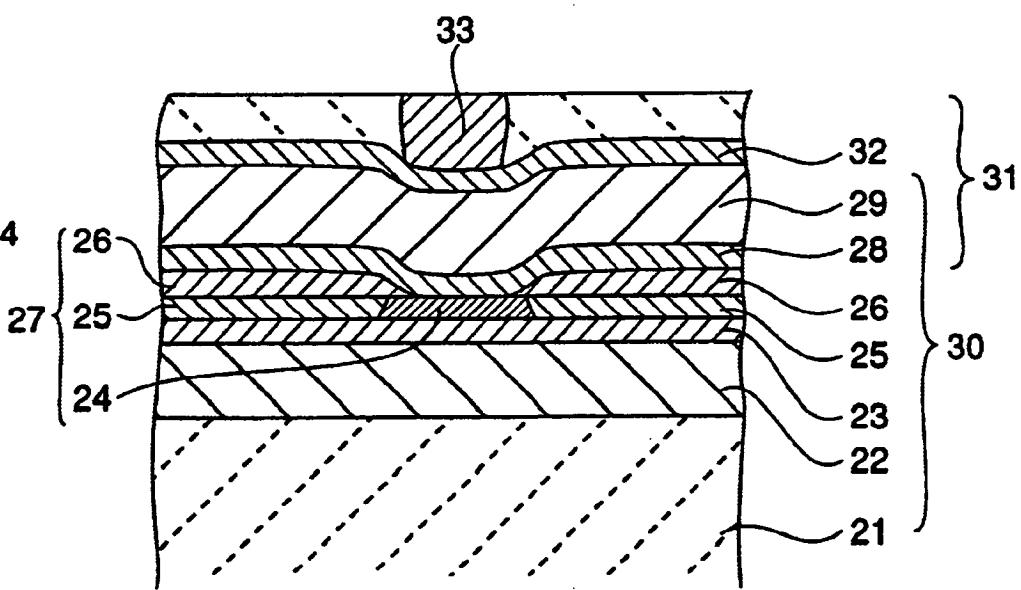
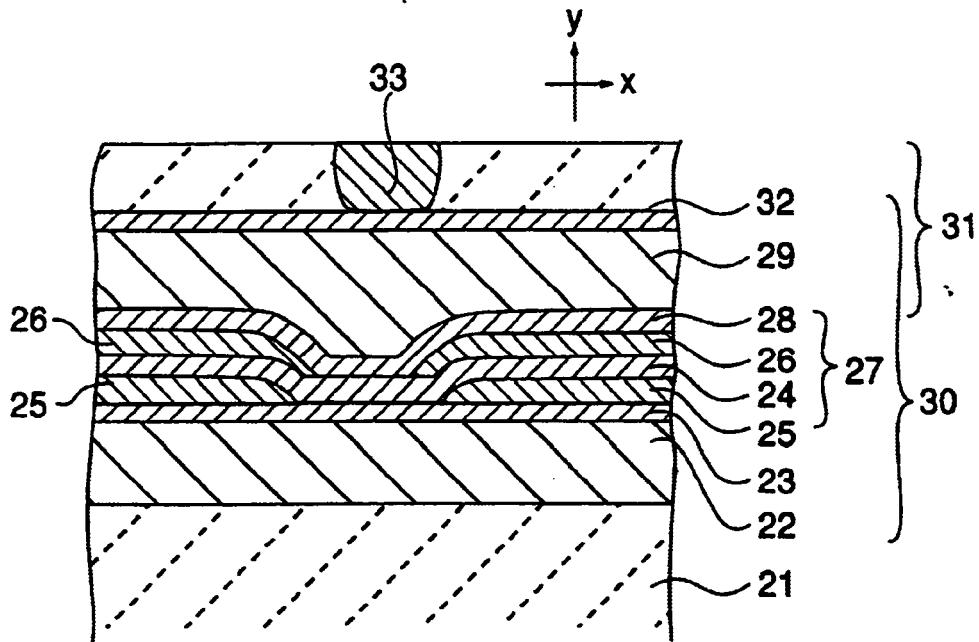


Fig.45



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Fig.46

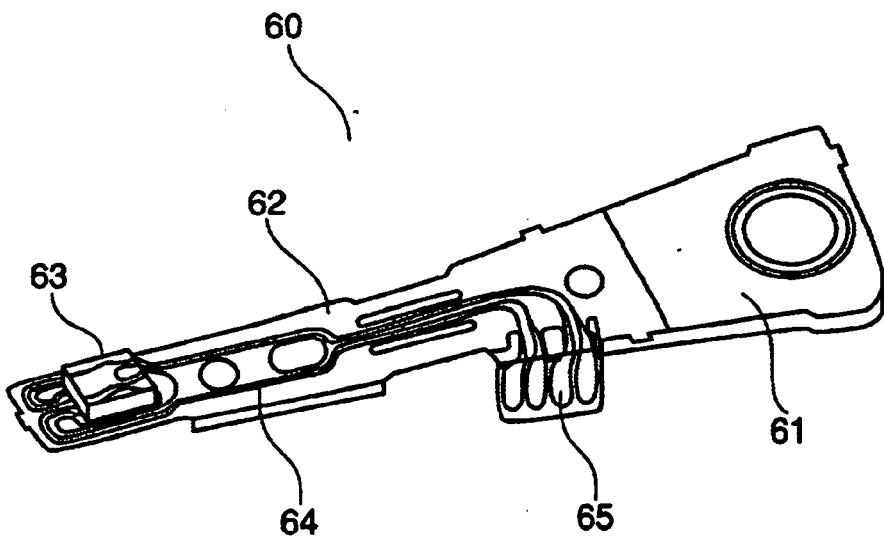
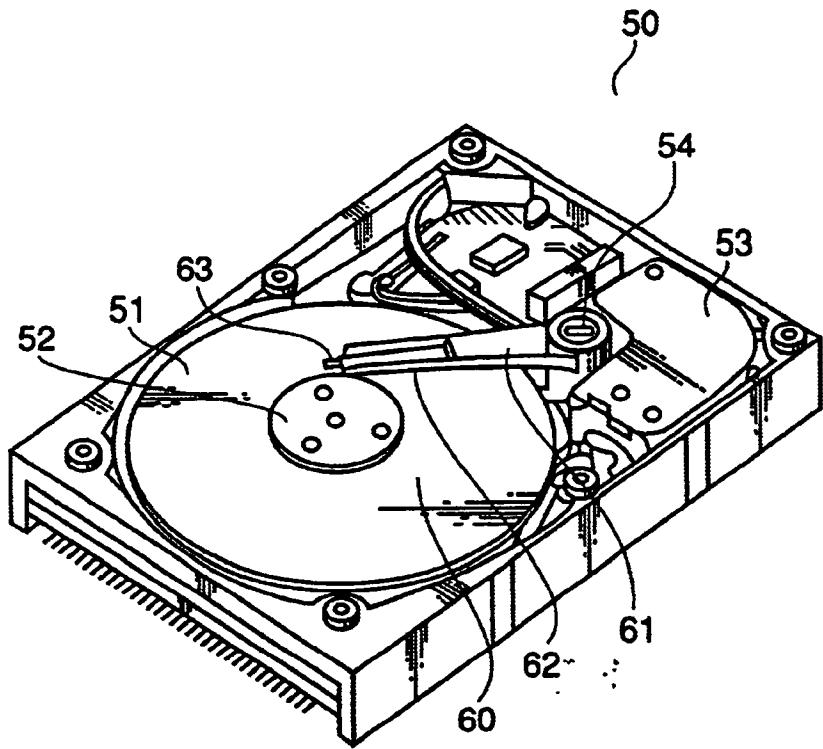


Fig.47.



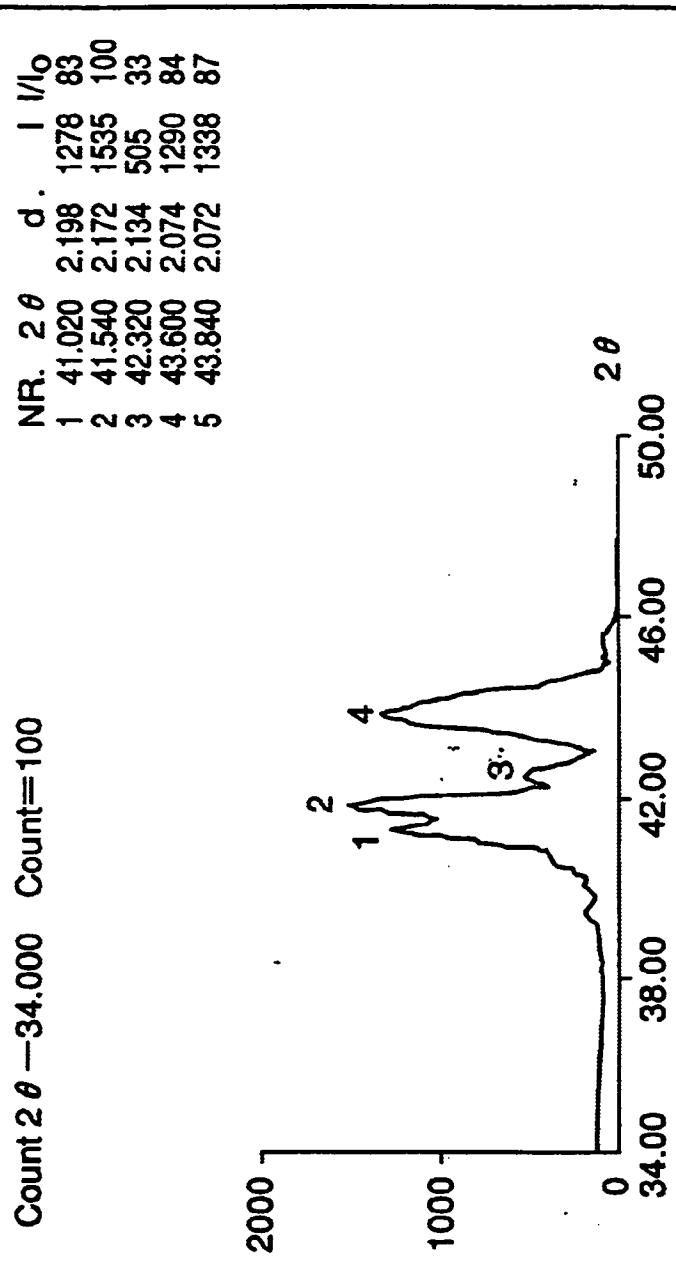
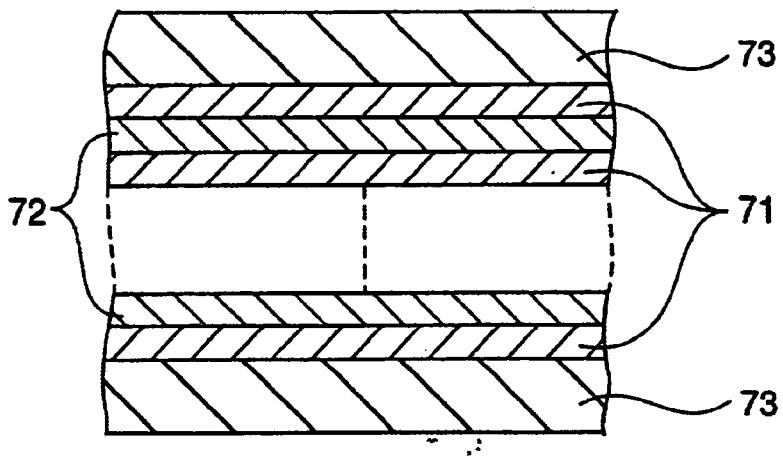


Fig.48

Fig.49



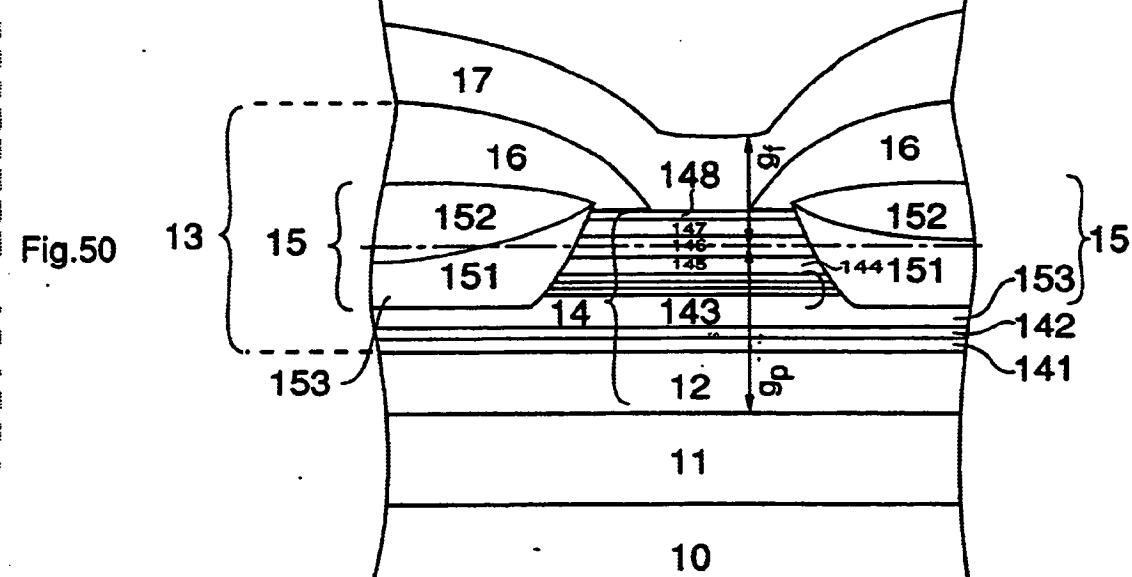


Fig.51

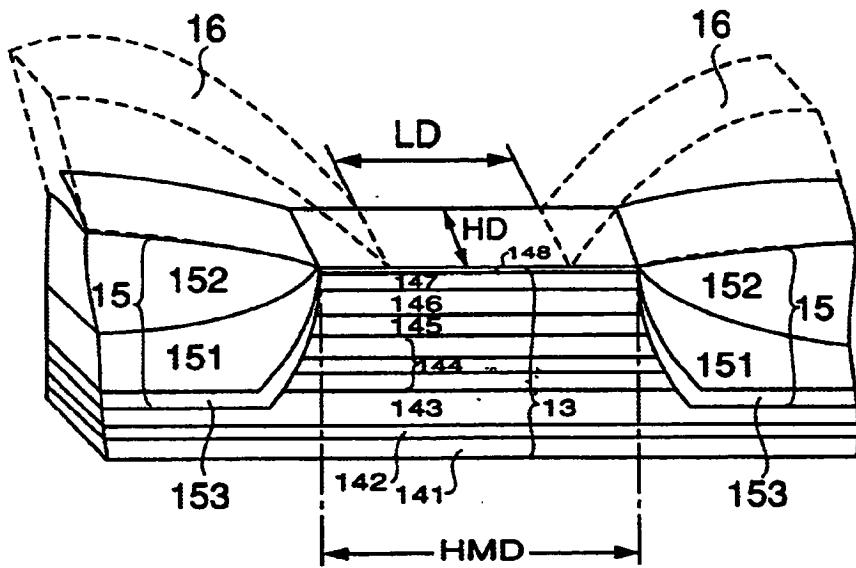


Fig.52

